

ON A RE-EXAMINATION OF THE TYPES OF KREFFT'S
SPECIES OF CESTODA IN THE AUSTRALIAN
MUSEUM, SYDNEY.

PART I.

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(From the Bureau of Microbiology, Sydney.)

(Plates i-vi.)

I.—INTRODUCTION.

If we consider what a vast vertebrate fauna—fish, amphibians, reptiles, birds, mammals,—Australia possesses, we must be struck with the extreme paucity of our knowledge of its parasitology and especially of its Platyhelminthic Entozoa. It is only the Cestoda which concern us here; a comparatively small number have been described. If we include only adult forms from the mainland, *i.e.* if we exclude those described from New Guinea and other East Indian Islands belonging to the Australasian zoogeographical section we will notice that there are only about ten tapeworms described (December 1910) more or less completely from our mammals, four of them being named by Kreffft and three by Zschokke; about seventeen from Australian birds, eleven being named by Kreffft, two by Linstow and two by myself; two from local fish, both described by Haswell; and two from reptiles, one being studied by me. In addition to these there have been a few identifications and more complete accounts given of parasites found in local hosts but previously described from extra-Australian hosts, *e.g.* *Gyrocotyle rugosa*, Dies., whose anatomy was given by Spencer. In some cases there is merely a reference to the identification of an Entozoon in a host in Australian territory, which has been described elsewhere, *e.g.* certain tapeworms from the Sunfish. Besides these a number of larval Cestoda have been described or identified from mammals, reptiles, amphibians and frogs by Haswell, Hill, myself and others. It should be mentioned that no notice has been taken of the introduced fauna, whether wild or domesticated, in the above estimate of our known Australian Cestoda.

From the foregoing it will be seen that Kreffft has described about half of the tapeworms known from the Australian mainland. His accounts and figures are very unsatisfactory and do not allow of the recognition of any of them, as his remarks are

generally confined to a few details regarding the dimensions, the general appearance of the strobila and the form of the scolex, and even these are not accurate. But for the fact that most of his types have been preserved in the Australian Museum, all of his species might be justifiably rejected. Many of the type specimens have become dried and are therefore of little or no use, but I have been fortunate enough in a few cases to find rather better preserved material which I have been able to identify as belonging to the same species as the types in question.

They have been commented upon by various authors but no definite pronouncement has so far been possible.

The re-examination of Krefft's species, therefore, seemed to me desirable, and the Curator kindly placed the original material at my disposal. In the following pages the majority of them receive more or less attention according to their state of preservation.

Krefft described sixteen species as follows¹ : —

- (1) *Tænia tuberculata*.
- (2) *Tænia novæ hollandiæ*.
- (3) *Tænia paradoxa*.
- (4) *Tænia forsteri*.
- (5) *Tænia fimbriata*.
- (6) *Tænia flavescens*.
- (7) *Tænia cylindrica*.
- (8) *Tænia coronata*.
- (9) *Tænia mastersii*.
- (10) *Tænia phalangistæ*.
- (11) *Tænia pediformis*.
- (12) *Tænia moschata*.
- (13) *Tænia rugosa*.
- (14) *Tænia chlamyderæ*.
- (15) *Tænia bairdii*.
- (16) *Bothriocephalus marginatus*.

All of the above, excepting Nos. 4, 5, 9, 10 and 16, are from birds, the exceptions being from mammals, the last three of them being from marsupials. Of the above sixteen specific names, five were already preoccupied in the genus *Tænia*, having been used by previous workers, and therefore Krefft's species require remaining if proved to be distinct. Under this list come (1) *T. fimbriata*, the name having been used previously by Batsch in 1786, and by Diesing in 1850 ; (2) *T. rugosa*, previously

¹ Krefft —Trans. Entom. Soc. N. S. Wales, ii., 1873, pp. 206-227.

employed by Pallas in 1760, and by Diesing in 1850; (3) *T. coronata*, used by Creplin in 1829; (4) *T. paradoxa* preoccupied through having been erected by Rudolphi in 1801; and (5) *T. tuberculata* also preoccupied by Rudolphi (1819). I have already ventured to rename the first as *T. krefftii*², the second as *T. hedleyi*³, and the third as *T. australiensis*⁴. The fourth appears very like his *T. nove-hollandiae* from the same host and consequently I have not thought it advisable to rename it until the specimens shall have been more carefully studied. In regard to *T. tuberculata*, the similarity to *Diploposthe levis*, Bloch, was sufficiently close to justify a further and more detailed examination of Kreff's species before altering its name. As will be seen later, *T. tuberculata* is synonymous with *D. levis*. *T. australiensis* is a typical member of the genus *Gyrocoelia*, *T. hedleyi* belonging to the allied genus *Acoleus*. *Tænia pediformis*, Kreff, is a *Fimbriaria* and moreover is synonymous with *F. fasciolaris*, Pall., more commonly known as *Tænia malleus*, Goeze. *T. forsteri* is a *Tetraphobus*, while *T. chlamyderæ* (*T. chlamydodære*) belongs to the genus *Choanotenia*, and *T. flavescens* to *Diorchis*. Both *T. bairdii* and *T. cylindrica* are species of *Hymenolepis*, the former being synonymous with *H. sinuosa*, Zeder, i.e. *H. collaris*, Batsch, while the latter is synonymous with *H. megalops*, Nitzsch. The types and only specimens of two of his forms have been lost and consequently these two species, *T. moschata* from the Musk Duck (*Biziura lobata*), and *T. phalangistæ* from the common Opossum (*Trichosurus vulpecula*), need not be any longer taken into account in Parasitology, as they are not recognisable from his descriptions. Both *T. mastersii* and *T. krefftii* belong to the Anoplocephalidæ. Fuhrmann has suggested that Kreff's *T. nove-hollandiae* may be a *Dioicocestus*, but this suggestion is based mainly on the fact that the host is a *Podiceps*.

From the foregoing remarks it will be seen that most of the species have been more or less examined. The most interesting forms are *T. coronata* (= *Gyrocoelia australiensis*), *T. rugosa* (= *Acoleus hedleyi*) and *T. tuberculata* (= *Diploposthe levis*). The first two belong to the Acoleidæ, a family characterised by the absence of a vagina and by the possession of a highly specialised musculature in the parenchyma, while the last possesses single genitalia, but doubled genital ducts and a characteristic arrangement of the body-musculature.

² Johnston—Proc. Linn. Soc. N. S. Wales, xxxiv., 1909, pp. 518-9.

³ Johnston—Journ. Roy. Soc. N. S. Wales, xlv., 1910, p. 94.

⁴ Johnston—Journ. Roy. Soc. N. S. Wales, xlv., 1910, p. 95.

II.—DESCRIPTION OF THE SPECIES.

TÆNIA TUBERCULATA, *Kreffl.*

[From the White-eyed Duck or Widgeon (*Aythya australis*, Gould).]

(Plate i.)

I propose first to describe as well as the macerated material will allow, the anatomy of *Tenia tuberculata*, Krefft, and then to discuss its systematic relationships. The imperfect condition of the specimens must be taken into consideration, especially as this account is based entirely on Krefft's type material. The main facts relating to the worm as given by Krefft⁵ are as follows:—Length seldom exceeding forty-two inches; average breadth one quarter inch, but may reach a half inch; head small; neck long; anterior end of the strobila very variable; no trace of the presence of suckers and rostellum; segments very narrow in anterior part of the chain; tubercles on the posterior segments; double genital papillæ in each segment; cirrus spiny and bell shaped; eggs circular and without hooks.

A glance at his figures will show that the material was in a poor state of preservation at that time, and its condition has not improved since. His account may accordingly be disregarded.

None of the scolices examined allow of the recognition of much detail. They are small and somewhat rounded and do not project at all laterally, but on the contrary, the scolex is the narrowest part of the strobila, being about 0·145 mm. in breadth in the region of the suckers. The latter are very weak structures when compared with the size of the parasite, being about 0·055 mm. in diameter. Their openings are directed antero-laterally.

A rather long, delicate eversible rostellum is present and is surrounded by a single circle of ten hooks. These are very small, being about 0·018 in length. The dorsal root is relatively long and rodlike, the ventral root short and rounded, and the claw small. The whole series is so closely clustered in the scolices examined that it is difficult to make out the exact form of each hook.

⁵ Krefft—*Loc. cit.*, pp. 215-16.

Behind the scolex the strobila gradually widens until at 0.33 mm. from the anterior end, that is at the point where segmentation becomes recognisable, the breadth is about 0.055 mm. The segments are here very narrow. Then there is a sudden increase in breadth though the proglottids still remain very narrow. Throughout the greater part of the strobila the width is short, seven or eight mm., though occasionally it reaches ten mm., the mature segments being from 0.7 to 1.3 mm. in length (average about one mm.) Segments 3.8 mm. broad by 0.7 mm. long were seen containing ripe eggs.

The genital papilla is more or less prominent according as the cirrus is everted or not. It is located just anteriorly to the middle of the edge of each segment. The genital eloa is somewhat elongate. The female opening is either immediately anterior to or beside the male opening, though at times it was seen to be below it.

The excretory system consists of the usual two pairs of trunks, an outer and an inner lying close beside it, the outer being very much the larger, having a lumen of from 0.01 to 0.02 mm. in transverse section. In cases where the diameter is less than this the margin is usually very much crinkled. Lying just internally to each outer tube is a very much smaller inner vessel with a lumen of only 0.004 mm. The parenchyma surrounding both and especially the inner vessel was deeply staining and contained abundance of nuclei. Both vessels lie at a considerable distance inwards from each lateral margin. They are situated in the medulla at about equal distances from the dorsal and ventral surfaces, but where the genital ducts cross over them, they become displaced ventrally. Transverse excretory vessels are absent.

The nervous system is composed of a number of longitudinal cords along each side as well as ring commissural nerves connecting the lateral cords of one side with those of the other. There are three nerves laterally, a median or main trunk and two accessory nerves, one slightly dorsally and one slightly ventrally. All three are connected by fibres. At certain levels and especially near the posterior end of each segment large paired nerves are given off dorsally and ventrally. These pass through the cortex to meet with similar structures from the other side to form ring commissures. The anterior commissural ring is much less evident. From the same point of origin as these ring nerves there are given off short but thick fibres laterally. The main longitudinal fibres lie ventrally to the genital ducts and the uterus. On the nerve ring in the neighbourhood of the

excretory vessels there may be seen in section other accessory longitudinal fibres. There is a ventral and dorsal pair on each side. There are thus ten longitudinal nerves, three pair of large laterals and two pair of smaller cords.

Musculature, etc.—In transverse sections the cuticle is seen to be rather thin. Below it lie the subcuticular structures consisting of very well developed circular muscles and within these the longitudinal fibres. The subcuticular cells are imperfectly preserved.

The separation between the cortex and medulla is not well marked owing to the poorly developed system of transverse muscle fibres. Lying in the peripheral part of the cortex there was an abundance of calcareous corpuscles of an elliptical or rounded form and possessing a diameter of from 0.005 - 0.012 mm.

The longitudinal muscular system of the parenchyma is very strongly developed. There are three distinct systems arranged concentrically. The innermost (Pl. i, fig. 1, l. m. 3) is just outside the transverse muscles and is practically restricted to that part of the cortex which lies above and below the female complex. There are here about eight well-marked bundles on each surface, and in addition there are a few isolated bundles lying laterally from the excretory vessels. As these latter occur within the other two systems they probably belong to the same series as those just mentioned. Just externally to this series is the ordinary longitudinal system consisting, as is frequently the case, of an inner (Pl. i., fig. 1., l. m. 2) and an outer (Pl. i., fig. 1, l. m. 1) series of bundles. The inner bundles are much larger, as also are the individual fibres, than those belonging to the outer series. The fibres, especially those of the larger bundles, were separated from each other, this being perhaps due to imperfect preservation. These two rings are generally easily distinguishable from each other except laterally where they become more or less merged. Even in the lateral portion of the cortex these bundles are still highly developed. In ripe segments it was noticed that the uterus frequently forced its way dorsally between the longitudinal bundles so as to lie against the subcuticula and in such cases the uterine lobes might be seen almost surrounding individual bundles (Pl. i., fig. 2). At the posterior end of each segment there is seen in sections, a mass of well developed transverse muscle. Connecting the dorsal and ventral surfaces there are a great number of strong dorso-ventral fibres.

Male Genitalia.—The male glands appear very early and do not persist, but disappear soon after the segment has reached

female maturity. There are three testes, all of about the same size, situated near the posterior border of each segment, fairly close to each other. Two may be on the right side, and the other on the left or *vice versa*. One of the former pair is sometimes nearly median in position, in which case it lies just behind and above the vitelline gland. The laterally placed vesicles are seen to lie postero-laterally from the main mass of the ovary and postero-medially from the vesiculæ seminales. The testes approach a little nearer to the dorsal surface than do the ovarian lobes. In transverse section they are seen to extend into the middle portion of the medulla. They are rounded or even pyriform in shape and measure about 0.156 by 0.117 mm. Two vasa efferentia pass away from each testis, one connecting with each vesicula seminalis. These seem to come off from the same point and to diverge from one another very soon.

There are in each segment two very large and conspicuous vesiculæ seminales which vary in size and shape according to the amount of spermatozoa contained in them. The usual form is rounded though it may be elongate or pyriform. In a few instances was seen to be bent in such a way as to form an obtuse angle. The size is about 0.144 mm. in diameter. Each lies quite ventrally in the anterior portion of the proglottid, just laterally to the ovary and antero-laterally to the outer testes. The corresponding vas deferens passes off laterally from its outer extremity. It is a more or less twisted tube which usually becomes thrown into a few coils just before entering the powerful cirrus sac. That part of each vas deferens which lies between the vesicula and the longitudinal excretory canals is surrounded by a dense mass of deeply staining cells, doubtless glandular in nature, which were too imperfectly preserved to allow of any detailed study of them. These are much more abundant on the inner region but gradually become smaller and fewer laterally, none being detected on the coiled portion of the vas deferens near the cirrus sac. Sometimes the glands cover the outer (*i.e.* lateral) wall of the vesicula too. In transverse section of the segment it is seen that the vas deferens in the neighbourhood of the vesicula lies either medianly or ventrally, but that it gradually curves dorsally to pass over the nerve and the excretory vessels, the latter being displaced towards the ventral surface in this region.

On entering the cirrus sac the vas deferens soon widens to form an inner vesicula with rather thin walls when compared with the remainder of the tube which lies within the sac and which possesses strong circular muscles in its walls. This part of the

male duct is very considerably coiled whilst the cirrus is lying at rest. A characteristic feature of the large tubular cirrus is the powerful armature of relatively large and very closely set and spirally arranged hooks which are seen in section of the organ to form a dense covering, the points projecting backwards. The cirrus sac is a large powerful organ, fusiform in shape and from 0.3 to 0.38 mm. long by from 0.18 to 0.23 mm. broad, in segments of 3 mm. in breadth, lying towards each antero-lateral corner of the segment. From it there pass inwards very distinct retractor fibres which travel towards the midregion of the segment. One notices that the parenchyma surrounding the sac is areolate and is very definitely marked off from the rest of the body-parenchyma. Within this is the true cirrus sac consisting of a very powerful thick longitudinal muscle surrounding a loose tissue which in turn encloses in its centre, the male duct. The walls of the latter possess a definite layer of circular muscle fibres. In the loose tissue there may be seen relatively large muscle fibres whose course is longitudinal to the cirrus into which they are inserted. They appear to act as retractors of the cirrus.

Female Glands.—The female complex consists of a compact mass of glands occupying the greater part of the middle of each segment, the breadth being about 0.7 mm. and the length 0.31 mm. in segments at 30 mm. distance from the anterior end. In transverse section the complex, especially the ovary, is seen to occupy most of the mid-region of the medulla extending longitudinally almost from the anterior to the posterior border of each segment and lying between the lateral testes and the vesiculae seminales in the transverse plane.

The ovary as a whole has an approximately vermiform shape, the vitelline and shell glands being located in the posteriorly directed hilum. Though there is an ovarian bridge present, yet it is very short and consequently one cannot readily recognise the existence of two wings. Each wing is made up of a great number of ovarian tubes arranged roughly in a radiating manner. The short thick ovarian bridge lies just in front of the vitellarium and shell-gland. From it there passes off postero-ventrally a very short oviduct which joins the fertilizing duct very close to the shell-gland complex.

The vitelline gland, as already mentioned, lies in a midline just behind and below the ovarian bridge. It is nearly 0.2 mm. in breadth and possesses an irregular shape, being deeply lobed. Its duct is short and passes downwards and forwards to enter the fertilising canal. The shell-gland complex is median and lies

just above and in front of the vitellarium being situated between the latter and the ovarian bridge. The complex as a whole is an elongate solid gland made up of a great number of granular deeply staining cells, whose inner end is narrowed and duct-like.

Each vagina is a wide tube leading from the corresponding female genital pore inwards and backwards to the middle of the segment where it meets its fellow from the other side. It then passes forward to enter into relationship with the various female glands. A more detailed account of its course may now be given. Each passes inwards close beside the wall of the cirrus sac along its dorsal surface. It then crosses over the lateral part of the vas deferens at about the point where the latter becomes thrown into a few loops or coils to lie postero-ventrally or ventrally to the male duct which it accompanies inwards as far as the inner end of the vesicula seminalis. In the region of the excretory canals the vagina lies between these and the more dorsally placed vas deferens, whilst in the neighbourhood of the vesicula, it lies on the ventral limit of the medulla. In this last locality it frequently becomes widened to form an elongate receptaculum seminis which extends still further inwards and backwards as will be mentioned below. Occasionally this portion of the vagina becomes swollen into a rounded reservoir of about the same shape and size as the vesicula seminalis which lies immediately anteriorly to it. In a longitudinal vertical section of a segment (Pl. i, fig. 2), the vagina and the vas deferens are seen in transverse sections as two adjacent tubes, the former possessing a wide lumen and thin walls, the latter a narrow lumen with thick walls containing longitudinal muscular fibres. The vagina now travels inwards, backwards and ventrally, skirting round the posterior border of the corresponding ovarian lobe, this part of the duct being fairly wide. The two vaginae unite medianly near the posterior margin of the segment to form a short wide common transverse tube from which the fertilising canal passes forwards. The oviduct and vitelline duct enter it from the neighbourhood of the shell-gland complex which is now penetrated. The duct then passes forwards to the transversely placed uterus. The vaginae persist in segments in which the uterus is well developed and in which the ovary has disappeared.

The uterus consists at first of a more or less transversely placed sac whose middle lies just posteriorly to the ovarian bridge. The long "wings" of the sac extend outwards and backwards between the ovarian tubes, and as they develop very rapidly they soon come to extend into the posterior corner of each

segment. The connecting (*i.e.* the median) portion is very narrow and remains so even in mature segments, so that in these latter the uterus consists of two large irregularly lobed structures which almost touch each other along the midline but which are actually connected only in the antero-dorsal part of the proglottid. As the uterus becomes filled with eggs the stalk-like portion of the wings comes to expand and lobes develop both in the dorso-ventral and horizontal planes, but more especially dorsally. The lateral growth takes place in such a way that the uterus lies dorsally to the excretory ducts and nerve, but partly folds round these to form a bay which is open towards the ventral surface. It also lies dorsally to the vesiculæ seminales and the inner portion of each vagina. The latter is seen in transverse and horizontal sections to skirt around the ventral edge of the uterus, and between it and the ventral layer of transverse muscle fibres. It penetrates between the dorsal longitudinal muscle bundles to the subcuticular cells, the muscles thus coming to be partly surrounded by the uterus (Pl. i., fig. 2). The tubercular appearance of many of the segments, a fact which led to Kreffit giving it the specific name of *tuberculata*, is partly due to this fact and partly to imperfect preservation. The uterine lobes or pouches in the transverse plane come near the surface and probably as a result of pressure brought about by the contraction of the powerful longitudinal and dorso-ventral fibres, a "tubercle" has been produced at the weakest point. In some of the sections it was noticed that the uterus had reached the surface. In entire stained preparations the pouches which lie just below the surface may be seen as a series of rounded structures projecting dorsally from the main mass of the sac.

The eggs possess two shells, the thin outermost covering being about 0.09 by 0.07 mm. Within this is a firm embryonic covering also of elliptical form, measuring 0.047 by 0.035 mm. A very delicate membrane surrounds it. The embryonal hooklets are curved and very small; Kreffit was not able to recognise them.

Systematic.—This parasite has been referred to by several authors and has been placed in no less than four different genera. Kreffit called it a *Tenia* as at his time this huge genus had not been divided up systematically to any extent. In 1891 Monticelli⁶ regarded it as a synonym of *Tenia bifaria*, von Sieb. In the same year Blanchard⁷ suggested that it might

⁶ Monticelli—Boll. Soc. Nat. Napoli, v., 1891, p. 153.

⁷ Blanchard—Mém. Soc. Zool. France, iv. 1891, p. 443.

be an *Ophryocotyle*. In 1893 Diamare⁸ erected a genus *Cotugnia* for tapeworms possessing double genitalia along with certain other characters and thought⁸ that *T. bifaria* might also belong to this genus. Stiles⁹ in 1896 followed Diamare and listed *T. tuberculata* as a synonym of *Cotugnia bifaria* but gave Monticelli's account and figures of the parasite. In 1900 Diamare¹⁰ referred to the imperfect account given by Krefft. In 1906 Fuhrmann¹¹ dealt with the synonymy of *Diploposthe laevis*, Bloch, and included *Tenia bifaria*, von Sieb. under it. He stated that *T. tuberculata* was in all probability a *Diploposthe* and was perhaps synonymous with *D. laevis* but on account of the difference between the geographical range of the Australian host species, and the Anseriform birds which may act as the host of *D. laevis* in the Northern Hemisphere, he thought that the two Cestodes might be distinct. Accordingly he listed Krefft's species as *Diploposthe? tuberculata* in 1908.¹² I have recently¹³ given a summary of the above facts, mentioning that the species was a true *Diploposthe*.

My detailed examination of Krefft's type material places beyond all doubt that his *T. tuberculata* is a synonym of *Diploposthe laevis*, Bloch. One has only to compare the above description and figures with those given by Jacobi¹⁴ in 1897, by Cohn¹⁵ in 1901, and by Kowalewski¹⁶ in 1903, in order to recognise the synonymy. Fuhrmann¹⁷, in a very important paper on the genus *Diploposthe* stated that he had examined the original material of *Tenia bifaria*, von Sieb., *Diploposthe lata*, Fuhrm.¹⁸, and *D. suigeneris*, Kowalewski¹⁹ and found them all to be synonymous with *D. laevis* Bloch. He also discussed several points concerning the anatomy of this species, in which Cohn,

⁸ Diamare—Boll. Soc. Nat. Napoli, vii., 1893, p. 12.

⁹ Stiles—Bull. Dept. Agr. U.S.A., Bur. Animal Industry, 12, 1896, pp. 30-1

¹⁰ Diamare—Centr. Bakt., xxviii., 1900, p. 849.

¹¹ Fuhrmann—Centr. Bakt. Orig., xl., 1906, pp. 217-224.

¹² Fuhrmann—Zoolog. Jahrb., Suppl. Bd. x., Heft, 1, 1908, p. 85.

¹³ Johnston—Journ. Roy. Soc. N. S. Wales, xlv., 1910, pp. 99-100.

¹⁴ Jacobi—Zool. Jahrb. Abth. Anat., x. 1897, pp. 287-306.

¹⁵ Cohn—Nova. Acta. Leop. Carol. Akad., lxxix., 1901, pp. 421-429.

¹⁶ Kowalewski—Bull. Acad. Sci. Cracovie, Classe Sci. math. nat., 1903 pp. 518-9.

¹⁷ Fuhrmann—Centr. Bakt. I., xl., 1906, pp. 217-224.

¹⁸ Fuhrmann—Zool. Anz., xxiii., 1900, pp. 50-1.

¹⁹ Kowalewski—Loc. cit., pp. 518-9.

Jacobi and Kowalewski differed from each other. *T. trichosoma*, Linstow²⁰, was mentioned as being very probably also a synonym. It seems to me that Fuhrmann is correct. Linstow's specimen was very small and immature. The rostellar hooks figured by him are very like those figured by Krabbe²¹, and those seen by me in Kreff's specimens. Other accounts dealing with this Cestode are those given in 1850 by Diesing²², in 1877 by Linstow²³ (dealing with the armature of the parasite), in 1882 by Krabbe²⁴, and in 1889²⁵ and 1891²⁶ by Monticelli. The last mentioned author has misinterpreted the various male and female glands, describing a double set of reproductive organs in each segment whereas the genitalia are single though the ducts are double. The main points of difference between our specimens and the account given by European workers, are unimportant. In the main I have found the relationships of the genitalia the same as those mentioned by Fuhrmann and Kowalewski especially by the former. Of the work of the latter only a relatively brief English résumé is available and one has to rely on the figures (which by the way are very good) for a great deal of detail.

The vaginae are much closer to the vasa deferentia in our specimens than is shown in Kowalewski's figures. The inner nerve ring mentioned by him was not recognised and the strongly developed anterior ring commissure mentioned by this author and by Cohn was scarcely recognisable though the posterior ring commissure was readily seen. The anastomoses between the vasa efferentia mentioned by him were not detected. The establishment of the identity of *T. tuberculata* with *D. levis*, very considerably widens the known range of this parasite which occurs in at least thirteen different genera belonging to the Anatidæ (Duck family)²⁷ in the Northern Hemisphere. Kreff's specimens were taken from *Aythya australis*, Gould, but I have recognised the same species amongst Kreff's Entozoa collected

²⁰ Linstow—Arch. Naturg., xlviii., 1882, p. 22.

²¹ Krabbe—Bidrag til Kundskab om Fuglenes Baendelorme in Dansk Vidensk Selsk. Skr. Naturvid, (5) viii., pp. 302-3. figs. 165, 166.

²² Diesing—Systema helminthum, 1850, p. 541.

²³ Linstow—Arch. Naturg., xliii., 1877, pp. 1-18.

²⁴ Krabbe—Dansk Vidensk. Selsk. Skr. Naturvid. Math. (6), i., 1882, pp. 349-366 (this work was not available to me).

²⁵ Monticelli—Proc. Zool. Soc., 1889, p. 325.

²⁶ Monticelli—Boll. Soc. Nat. Napoli, v., 1891, pp. 151-3.

²⁷ For list see Fuhrmann, 1906, *Loc. cit.*, p. 217, also Fuhrmann, 1908, *Loc. cit.* under the various hosts mentioned.

from the Black Duck (*Anas superciliosa*, Gmel.), and the Teal (*Nettion castaneum*, Eyton), which are therefore newly recorded hosts for *Diploposthe levis*, Bloch.

TENIA FORSTERI, *Kreffl.*

The description of *Tenia forsteri*, a parasite taken from the stomach of a Dolphin (*Delphinus forsteri*, Gray ?), in Port Jackson, as given by Krefft²⁸ is very scanty. Consequently Cobbold²⁹ suggested that this Cestode might belong to the species named by Diesing³⁰ in 1850 as *Tetrabotheium triangulare* from *Delphinorhynchus rostratus*, Cuv. In 1892 Monticelli³¹ described a tapeworm from *Delphinus delphis*, Linn., from the Bay of Naples, which he referred to Krefft's species as it agreed with the latter in the few points mentioned by Krefft. He gave a short account and figures of the anatomy making the species the type of a new genus, *Prostheocotyle*. In 1899 Fuhrmann³² discussed this genus giving a résumé of the known species, including *P. forsteri* and *P. triangulare*, the descriptions of these being based on the original material of Monticelli and Diesing respectively. In 1904 he gave a much fuller account³³ of these two parasites. Lühe in 1899 showed that the Genus *Prostheocotyle* is synonymous with *Tetrabotheium*, Rud.

From the above, it will be seen that some pronouncement in regard to *Tetrabotheium forsteri* may be of use. Unfortunately the type material has become dried up and is now useless for the purpose of systematic study. Consequently I am able to give only a few details, which will be supplemented by further information derived from the descriptions of Monticelli and Fuhrmann.

The scolices have not been much affected by the drying, but the attempt to follow out the anatomy of the segments was quite unsuccessful. The scolex is about 0.43 mm. in breadth, (0.28 mm. in Fuhrmann), and bears four very prominent muscular suckers, with a deep cup-like cavity and a rounded or oval opening 0.157 mm. in breadth by 0.19 mm. in length. Each sucker is nearly

²⁸ Krefft—*Loc. cit.* p. 218.

²⁹ Cobbold—Parasites—A Treatise on the Entozoa, 1879, p. 422.

³⁰ Diesing—Systema helminthum, i., 1850, p. 601.

³¹ Monticelli—Boll. Mus. Zool. Anat. Comp. R. Univ. Torino, vii., 1892, No. 27, pp. 6-8.

³² Fuhrmann—Centr. Bakt. Orig. i., xxv., 1899, pp. 869-870.

³³ Fuhrmann—Centr. Bakt. Orig. i., xxxv., 1904, pp. 744-752.

spherical and between each pair there is a deep narrow groove. Situated on the outer and anterior edge of each there is a small auricle, a muscular appendage characteristic of the genus *Tetrabothrius*.

Immediately behind the scolex there is a narrower unsegmented neck-region, which is soon followed by the segmented portion of the strobila. The specimens do not allow of any further detail being given except that the segments gradually increase in size until the last few proglottids are reached, these being rather longer and narrower than those further forward. Krefft gave the length of the worm as being two and a half inches (= about 52 mm.). He also stated that the segments were not provided with "lemnisci," this implying that he did not see the cirrus. The characters of the scolex resemble the figures given by Monticelli³⁴ so closely that there is no doubt as to the identity of the two parasites. The breadth is very much greater than that given by Fuhrmann (0.28 mm.). The length according to the latter may be from 25 to 65 mm.

The following summary account of the anatomy is based mainly on that given by this author. The longitudinal musculature consists of an inner series of bundles of fibres, each bundle with from twelve to twenty fibres and an outer series in which there are fewer (three to six) fibres in the individual bundles. The transverse and dorso-ventral muscles are well developed. There are no commissural vessels in the scolex connecting the excretory canals of the one side with those of the other.

The genital atrium is narrow and deep, the cirrus sac opening into it dorsally and the vagina ventrally. The male duct does not open directly into the cloaca but first into a male canal which connects with the latter. According to Monticelli's figure the pores (which are situated on the right side) seem to be placed at about the middle of the margin of the segments.

The male organs consist of about twenty-two testes (instead of from five to seven as mentioned and figured by Monticelli) arranged around the female organs. The vas deferens after being thrown into coils, passes out laterally to terminate in a long cirrus lying in the muscular rounded cirrus sac which has a diameter of 0.072 mm. This in turn leads into a short male canal terminating in the genital cloaca dorsally to the vagina.

³⁴ Monticelli—*Loc. cit.*, figs. 4, 5, 6.

The female organs lie ventrally. The large slightly lobed ovary is situated in the middle of the posterior half of the segment behind the testes and the vitellarium. The vagina passes out dorsally and, as already mentioned, opens ventrally to the male aperture. A receptaculum seminis is absent. The vitelline gland is a compact organ lying just in front of the middle of the ovary, this position of the yolk gland being a characteristic of the genus. The uterus is at first a dorsally placed transverse tube which eventually becomes sac-like and occupies almost the whole of the medulla.

In regard to Cobbold's suggestion of identity between *T. forsteri* and *T. triangularis*, a comparison of the description of each as given by Fuhrmann³⁵ is sufficient to show that the two are distinct. Dr. G. Sweet³⁶ has misquoted the latter author as having examined specimens of *T. triangularis* from dolphins captured in Sydney Harbour.

TÆNIA FLAVESCENS, Krefft.

(Plate ii.)

This parasite was described very meagrely by Krefft³⁷, the hosts mentioned being the Black-duck (*Anas superciliosa*, Gmel.) and the Blue-wing Shoveller (*Spatula rhynchotis*, Lath.). I am now able to add the following additional hosts, the Teal (*Nettion castaneum*, Eyton), and the White-eyed duck (*Aythya australis*, Gould), from New South Wales.

The original account of this Cestode is insufficient, and, in many details, incorrect. It may, therefore, be disregarded. The following description is based upon an examination of the type material from *Anas superciliosa*, from which it will be seen that *T. flavescens* is a typical member of the genus *Diorchis*.

Diorchis flavescens is a rather narrow worm of about one millimetre in maximum breadth. Most of the specimens were from three to five centimetres long, though some were much longer, one exceeding 8.4 cms. The scolex is small, being 0.195 mm. in width. The suckers are fairly well developed, the diameter reaching nearly 0.1 mm. (Pl. ii., fig. 1). The cuticle lining them is provided with abundance of minute spines

³⁵ Fuhrmann—Centr. Bakt. Orig., i., xxxv., 1904, p. 748.

³⁶ Sweet—Proc. Roy. Soc. Vict., xxi. (n.s.), 1909, p. 479.

³⁷ Krefft—Loc. cit., p. 219.

resembling those present in certain species of *Ichthyotenia* (*Proteocephalus*)³⁸ and in some species of *Diorchis*³⁹ (*D. acuminata*, Clerc, and *D. americana*, Ransom). The rostellum when fully everted is a prominent organ of 0.103 mm. in length, the width of the somewhat swollen extremity being 0.08 mm. Situated on this latter portion are the ten hooks (about 0.068 mm. long) arranged in a single circle. As in other members of the genus the dorsal root of the hook is relatively long (0.042 mm.), the ventral root being short and rounded. The claw is 0.025 mm. in length. The form of the hook is seen in Pl. ii., fig. 3. The rostellum may be so deeply retracted that the hooks lie on a level with the lower part of the suckers (Pl. ii., fig. 2). Connected with this rostellum is a strongly muscular rostellar sac whose inner limit lies behind the level of the suckers.

The scolex is succeeded by a short unsegmented neck of variable length but whose breadth (0.14 mm.) is only slightly less than that of the scolex. The first segments are very short but they gradually increase both in length and width. In proglottids in which male sexual maturity has been reached, the sizes are 0.11 by 0.5 mm. With advancing female maturity the segments become broader (0.90 mm.) and relatively shorter (0.096 mm.), whilst those which contain ripe eggs may measure 0.174 mm. in length by one mm. in breadth.

Body-wall, etc.—The specimens are too poorly preserved to allow of an examination of the subcuticular structures. Calcareous corpuscles are very abundant. They are elliptical in form, varying somewhat in size, their average being about 0.0078 by 0.0045 mm. They are restricted to the outer layers of the cortex. The lateral nerve is situated at about midway between the excretory vessels and the margin of the segment, the genital ducts passing over it. The parenchyma musculature is well-developed, the longitudinal bundles being arranged in two series, an outer ring consisting of numerous small bundles and an inner series of eight large bundles (Pl. ii., fig. 8), each consisting of a number of very powerful fibres. The arrangement of the longitudinal musculature seems to be typical in this genus. Transverse fibres appear to be very poorly developed.

The excretory system consists of a larger ventral and a smaller dorsal pair, the latter lying above and sometimes slightly laterally from the former. Both lie ventrally to the genital ducts on the

³⁸ Johnston—Journ. Roy. Soc. N. S. Wales, xlili., 1909, p. 103, etc.

³⁹ Ransom—Bull. U. S. Nat. Museum, 69, 1903, p. 42, etc.

pore-bearing side. They are situated at a rather lower dorso-ventral level on this side than on the opposite side, a feature similar to that found in other species of *Diorchis*. Transverse vessels were not seen. There appears to be a valve-like projection into the lumen of each ventral vessel near the posterior edge of each segment (Pl. ii., fig. 4).

Genitalia.—The genital apertures are unilateral, being located on the right side. They lie marginally in front of the middle of the edge, being usually at the junction of the anterior third with the posterior two-thirds. A distinct papilla is absent. There may be a very short narrow common genital cloaca into which the male and female apertures open, the female pore being immediately below that of the male system. As already remarked the genital canals pass above the longitudinal nerve and both excretory vessels.

The male organs consist of two large testes placed more or less symmetrically in the posterior portion of the segment. They appear early but develop slowly for a considerable distance back from the anterior end, when they begin to increase very suddenly in size at the time of male maturity. They then occupy a large part of the medulla lying between the excretory vessels, the diameter of each being almost 0.1 mm. Sometimes they are quite close together, especially in all the younger segments (Pl. ii., fig. 5), but with increasing size of the glands and the seminal vesicle their symmetrical arrangement becomes disturbed (Pl. ii., fig. 6). A large mass of spermatozoa comes to be stored in the vesicula seminalis after which the male glands commence to dwindle rapidly, the female organs meanwhile coming to maturity. The vesicula in ripe segments is a large rounded structure lying near the dorsal surface in the anterior portion of the segment. Its position is seen to vary, being usually above and in front of the testes which is remote from the genital pore in young segments but in proglottids which have reached male maturity it usually lies rather nearer the midline separating the two glands. A much narrower tube connects the vesicula with the cirrus sac. The cirrus sac is a long, more or less tubular, slightly twisted structure of from 0.270 to 0.35 mm. in length, with a maximum breadth of about 0.050 mm., lying dorsally in the anterior portion of the segment. The broadest part is towards its inner end, the other end being much narrower (0.03 mm.). The organ stretches inwards almost to the midline, and occasionally much further. Its musculature is somewhat thicker around the middle. There is a small seminal vesicle within the sac.

The cirrus is very long and slender and when at rest lies irregularly and loosely coiled. It can be thrust out to a very considerable degree, the everted portions actually reaching 0.50 mm. in one case observed, the width of the segment to which it belonged being 0.92 mm. In the case of other cirri the length was much less, but eversion was not complete. Each cirrus is thus a very long delicate tube, its maximum breadth being 0.0054 mm. It does not possess a basal enlargement like that found in *D. inflata* and *D. acuminata*. Unlike these species and *D. americana*, *D. flavescens* shows the presence of a minute armature on the cirrus.

The female glands consist of a compact trilobed ovary lying ventrally in the midregion of the segment and of a vitelline gland, situated dorso-posteriorly to it. The mature ovary extends from the excretory vessels of the one side to those of the other, being about 0.39 mm. in width. Of the three lobes, one lies medianly in front of and between the other two which are lateral. The median is smaller than either of the others. The yolk-gland is either rounded or kidney-shaped and lies at the posterior edge of the segment, its position being more dorsal than that of the ovary. The vagina travels inwards immediately behind and somewhat ventrally to the cirrus sac in a number of wide rather closely arranged coils. Its general course is inwards and slightly backwards until it opens into a spacious thin-walled receptaculum seminis which extends inwards in mature segments to about the middle of the ovary, as an elongate wide tube. It lies above the excretory vessels and the ovary, and ventrally to the cirrus sac, vesicula seminalis, and testes. Its position is at a slightly higher dorsal level than that of the vagina. The uterus in mature proglottids is a sac-like organ lying ventrally but occupying most of the medulla between the excretory vessels of each side, except in the anterior region of each segment where the male and female ducts and reservoirs are situated. It also extends laterally above the excretory vessels on the pore-bearing side but below them on the opposite side of the segment. Thus the excretory vessels come to lie in a bay or groove formed by the uterus which partly surrounds them. The mature eggs are from 0.090 to 0.107 mm. in length and from 0.027 to 0.031 mm. in breadth. Each end is somewhat bluntly pointed, while each extremity of the inner shell is produced into a very prominent process. The inner shell measures from 0.054 to 0.068 mm. in length by about 0.016 mm. in breadth.

Systematic.—There appear to be only four other species of *Diorchis* known^{39*} viz. *D. inflata*, Rud., *D. parviceps*, Linst., *D. acuminata*, Clerc, and *D. americana*, Ransom. The first, third and fourth occur in Galliform birds, the second, and perhaps also the third, in Anseriform birds. *D. flavescens* is also a parasite of the latter group of birds. It appears to come very near *D. americana*⁴⁰. *D. parviceps*, Linst.⁴¹ from *Mergus* (= *Merganser*) *serrator*, differs considerably in regard to the rostellar armature and the male ducts. *D. inflata*⁴² and *D. acuminata*⁴³ are very closely allied and perhaps identical, species differing from Krefft's form mainly in regard to the characters of the cirrus and its sac. It should be mentioned that Clerc found *D. acuminata* in a Rail, *Fulica atra* (in which *D. inflata* is also found) as well as in three Anseriform birds, *Anas* (= *Nettion*) *crecca*, *A.* (= *Chaulelasmus*) *strepera* and *Mareca penelope*. Fuhrmann⁴⁴ thought that the identification of the *Diorchis* from the Rail with that from the various ducks was probably a mistake, consequently he queried the occurrence of *D. acuminata* in *Fulica atra*. Ransom⁴⁵ however showed that this Cestode occurs in another Rail (*Fulica americana*) in company with *D. americana*. It seems to me still possible that Clerc had before him two species of *Diorchis*, namely, *D. acuminata* (or *D. inflata*) from *Fulica atra* and another species, very similar in anatomy and which might well have been *D. flavescens*, from the Anseriform birds.

^{39*} *Diorchis oclusa*, Linst. (Linstow—*Spolia Zeylanica*, iii., 1905, p. 179) from a Flamingo is not a *Diorchis* but is a *Hymenolepis*, synonymous with *H. liguloides*, Gervais, according to Fuhrmann (*Zool. Jahrb., Suppl. Bd. x.*, Heft 1., 1908, p. 76, footnote).

⁴⁰ Ransom—*Bull. U.S. Nat. Museum*, 69, 1909, pp. 48-51.

⁴¹ Linstow—*Arch. Naturg.*, 1872, xxxviii., p. 57; *Id.*, *Arch. Naturg.*, 1904, I., pp. 306-7.

⁴² Krabbe—*Bidrag. etc.*, 1869, pp. 285-6., and figs. 109-111; Jacobi—*Zool. Jahrb. Syst.*, xii., 1898, pp. 95-104; Cohn—*Centr. Bakt.*, I., xxv., 1899, pp. 224-5; Riggenbach—*Centr. Bakt.*, I., xxv., 1899, pp. 885-6 (Referate); Cohn—*Nova Acta*, lxxix., 1901, p. 330; Clerc—*Rev. Suisse Zool.*, xi., 1903, p. 284 (not available to me); Linstow—*Zool. Jahrb. Syst.*, xxiv., 1906, pp. 15-17; Fuhrmann—*Zool. Jahrb., Suppl. Bd. x.*, Heft 1, 1908, p. 81; *Id.*, *Centr. Bakt.*, etc., I., *Orig.*, xlii., 1906, p. 739 (footnote); Ransom—*Loc. cit.*, p. 46.

⁴³ Clerc—*Zool. Anz.*, xxv., 1902, p. 659; *Id.*, *Rev. Suisse Zool.*, xi., 1903, pp. 281-284. (not available): Ransom—*Loc. cit.*, pp. 42-48 (an abstract of Clerc's latter paper is given here).

⁴⁴ Fuhrmann—*Loc. cit.*, p. 7, p. 81.

⁴⁵ Ransom—*Loc. cit.*, p. 48.

TENIA BAIRDII, *Kreffl.*

(Plate iii.)

In giving a description of this Cestode from the Black Duck (*Anas superciliosa*), Krefft⁴⁶ mentioned that he had also found it in some other ducks but did not specify their names. I have found a few fragments of this species amongst some of his material collected from the intestine of the Teal (*Nettion castaneum*) which is therefore a newly recorded host for the Entozoon under review. The type specimen consists of a dried fragment which is of very little value. However, I have been able to recognise a few fragments from collections of material taken by Krefft from both of the abovenamed hosts and can therefore give some information regarding the parasite. No scolices were found and as the specimens are badly preserved, the descriptions cannot be otherwise than incomplete.

Krefft's account is very poor, and moreover includes at least three species, all of them belonging to the genus *Hymenolepis*. He himself admits (p. 224) that he found two varieties of ova. The small forms mentioned by him on page 226 and figured on his Pl. iii., figs. 25, 26, 27, belong to a different species. In a footnote on page 227 he mentioned that he regarded a tapeworm (Krefft's Pl. iii., figs. 24, 24a) found by him in a "Stilted Plover" (probably referring to *Himantopus leucocephalus*) as belonging to this species on account of the similarity of the ova. This latter form is no doubt also a *Hymenolepis* and may be identical with *Hymenolepis*, sp. already recorded by me⁴⁷ from this host. It is certainly not identical with *H. bairdii*. If Krefft's figures of the scolex (Pl. iii., figs. 1, 5, 8) refer to the same form as that examined by me, then the scolex appears to be well marked, possessing large suckers and a well-developed retractile rostellum bearing a few relatively large hooks. He mentioned that the strobila rarely exceeded seven inches in length and that the segments varied in shape. The variation in form is represented in Pl. iii., figs. 1, 2, 3, the first being taken from the anterior portion of one of Krefft's fragments, the second from part of the strobila a little further back and the third from segments which have reached male sexual maturity. In some better preserved

⁴⁶ Krefft—*Loc. cit.*, pp. 224-7.

⁴⁷ Johnston—*Journ. Roy. Soc. N. S. Wales*, xlv., 1910, p. 95.

material the proglottids are much less variable, and resemble those shown in Pl. iii., fig. 3, except that the margins are more definitely serrate.

No subcuticular structures are recognisable on account of the maceration which the specimens have undergone. Calcareous corpuscles are very abundant in the cortex. They are rounded or elliptical, varying in size from 0.004 by 0.0035 to 0.0118 mm. by 0.0095. The outer longitudinal muscle bundles are well developed and are distributed throughout the outer portion of the cortex. The inner series consists of a well marked ring of relatively large and numerous bundles arranged in a double row, those in the inner row being larger and less numerous than those in the outer row. Transverse fibres were recognised only in a few sections.

The excretory system consists of a wide ventral and a narrow dorsal vessel, the latter being situated just above the former. The genital ducts pass above both of them. Transverse vessels were not detected. The longitudinal nerve is located dorso-laterally from the ventral vessel.

Genitalia.—The genital pore is placed marginally and unilaterally at the junction of the anterior third with the posterior two-thirds, there being no distinct papilla. The cloaca is moderately long, its outer part being narrow while its inner end is relatively wide. Into the latter there open the male and female ducts, the latter being behind and below the former.

Lying on the antero-dorsal part of the inner end of the cloaca and opening into it there is a peculiar sac similar to that described as being present in *Hymenolepis sinuosa*, Zeder. Its walls are lined by cuticle and within this layer there are very strongly developed muscles, most of which radiate from the sac, while a few ring fibres are also present. The cuticle appears to be minutely spiny but this appearance is due to ends of the radial muscles which give a "stippled" effect like that produced by minute bristles. No spines were seen in sections of the sac. The wide opening of this organ lies beside and above the male opening, the sac itself which lies antero-dorsally to the outer end of the cirrus sac, apparently acting in some way as an accessory male organ. Two of the testes are situated on that side of the ovary which is remote from the genital pore, the other vesicle being on the opposite side. As will be seen from the figure (Pl. iii., fig. 3) two of the glands lie behind the female complex. They are approximately equal in size, measuring about 0.113 by 0.08 mm. They disappear soon after reaching maturity, the

vesicula seminalis having become by this time greatly swollen on account of the contained male products. The latter is an elongate bent organ lying in front of the ovary and passing laterally round and above the inner portion of the cirrus sac and coming to lie dorsally to and sometimes in front of it. It eventually opens into the sac, its inner portion being slightly coiled. An inner vesicula was not seen. The cirrus is relatively very long (0.43 to 0.52 mm.) and thin (0.008 mm. broad), its muscular walls being covered with a dense armature of very fine bristles like those of the accessory sac. The cirrus sac is an elongate organ about 0.56 mm. in length and 0.087 mm. in maximum breadth tapering somewhat laterally, lying in the anterior portion of the segment. Its walls contain a well-developed musculature. The sac passes inwards dorsally above the excretory vessels and then bends ventrally so that its inner end lies below the vesicula seminalis.

The female glands lie between the testes but the specimens are so poorly preserved that very little detail can be made out. The ovary appears to be a small bilobed organ lying just behind the middle of the proglottis and just anteriorly to the two posterior testes. The vitellarium, a rounded compact gland, lies postero-ventrally to the short ovarian bridge, the shell gland being situated antero-dorsally to the yolk gland and postero-dorsally to the ovary. The uterus is seen to be a transverse tube which later becomes more or less sac-like. Ripe eggs were not present.

The vagina passes inwards from the female pore for a short distance as a wide thin-walled duct. It then becomes narrowed to travel as a thin and very definite tube in a more or less sinuous course dorsally forwards and inwards above the cirrus sac. Its walls are covered with very minute bristles. Just in front of the sac, it enters the relatively large thin-walled spindle-shaped receptaculum seminis. The latter passes backwards below the cirrus sac and becomes narrowed to form the short fertilising duct in front of the ovary.

In spite of the incompleteness of the above description, it will be seen that there can be no doubt as to the identity of Kreffl's species with *Hymenolepis sinuosa*, Zeder, or more correctly *H. collaris*, Batsch⁴⁸, as described by various authors, such as

⁴⁸ Fuhrmann—Zool. Jahrb., Suppl. Bd. x., Heft 1, 1908, p. 77.

Dujardin⁴⁹, Diesing⁵⁰, Krabbe⁵¹, Stiles⁵², Kowalewski⁵³, and Cohn⁵⁴, who have dealt with the parasite. It is therefore of considerable interest that the distribution of this Cestode which is known to infest at least eight species of Anseriform birds⁵⁵ ranging mainly over the Northern Hemisphere should now be widely increased by the addition of two other hosts, viz. *Anas superciliosa*, Gmel., and *Nettion castaneum*, Eyton, from the Australian region. We may therefore expect to find the larval or cercocystis stage in some of our local freshwater Crustacea. Certain species of *Gammarus* and *Cyclops* are known as its intermediate hosts⁵⁶ in Europe.

TENIA RUGOSA, *Kreff.*

[From the White-headed Stilt, (*Himantopus leucocephalus*, Gould).]

(Plate iv.)

Kreff's account of this parasite may be disregarded, and his type specimens, or rather fragments, are now dried and therefore of no use for anatomical purposes. However, I have been able to compare some fresh material collected from this host in South Australia by Dr. J. B. Cleland, with Kreff's original specimens and with his description, with the result that I believe the two forms belong to the same species. It was the armature of the cirrus sac which assisted me in establishing the identity. A cursory examination of the South Australian worm was sufficient to allow me to place the parasite in the family Acoelidæ, and to remark that it probably belonged to the genus

⁴⁹ Dujardin—Hist. Nat. Helm., 1845, p. 573.

⁵⁰ Diesing—Syst. Helm., i., 1870, p. 542.

⁵¹ Krabbe—Bidrag., etc., 1869, pp. 298-9.

⁵² Stiles—Bull. Bur. Animal Industry, Dept. Agr. U.S.A., 12, 1896, pp. 40-41.

⁵³ Kowalewski—Bull. Acad. Sci. Cracovie, Cl. Sci. Math. Nat., xxix., 1895, pp. 349-367.

⁵⁴ Cohn—Nova Acta, lxxix., 1901, pp. 323-5.

⁵⁵ For list see Fuhrmann—*Loc. cit.*, pp. 149-155; Ransom—Bull. Bur. Animal Industry, Dept. Agr. U.S.A., 66, 1903, p. 92; Stiles—*Loc. cit.*, p. 40.

⁵⁶ Stiles—*Loc. cit.*, pp. 40-1; Hamann—Jen. Zeitschr. Naturwiss., xxiv., 1889, pp. 1-7; Mrazek, quoted Stiles, *Loc. cit.*, p. 41.

*Acoleus*⁵⁷. A further study shows it to be a member of this genus. As already noted, the specific name *rugosa* is preoccupied in the genus *Tænia*, having been used by Pallas in 1760, for a tapeworm from certain fish, and by Diesing in 1850 for a Cestode from a monkey. A new specific name *hedleyi* was therefore suggested for this Entozoon which will now be described under the name of *Acoleus hedleyi*.

This parasite is a large multi-segmented worm of about 230 mm. in length, with a maximum breadth of nearly 4 mm. At the anterior end is the scolex which is scarcely any wider than the succeeding segments, being 0.7 mm. in breadth. The length excluding the rostellum is about 0.34 mm. Owing to the fact that the rostellum is completely withdrawn in the single scolex in my possession, very little can be said of it or of its armature. The suckers have a diameter of 0.26 mm., the apertures being directed almost anteriorly. There is no unsegmented neck region, segmentation being recognisable immediately behind the head. The first proglottis is about 0.6 mm. wide by 0.065 mm. long, the ratio of breadth to length being approximately 9 : 1. At 1.7 mm. from the anterior end the strobila becomes much broader, the posterior margins of the segments now projecting prominently whereas in the case of the first few segments the projection is slight. At 10 mm. the breadth is nearly 3 mm. the length being 0.43, the ratio being 7 : 1. At 70 mm. behind the scolex the breadth is 3.6 mm. the length having increased to 1.7 mm., the ratio thus being about 2 : 1. At 100 mm., the dimensions are 3.8 mm. and 2.4 respectively, *i.e.* nearly 3 : 2, while at 150 mm. they are 4.2 and 2.5 respectively. The final segments are very thick (2.2 mm.) more or less quadrate structures 3.5 mm. broad by 3.0 mm. long. The increase in thickness takes place as maturity progresses.

Body-wall, Musculature, etc.—Below the thin cuticle is a well defined subcuticular layer with circular and longitudinal muscle fibres. The musculature of the parenchyma is very similar to that of *Acoleus vaginatus*, and *Gyrocotelia perversa*, as described by Fuhrmann⁵⁸. The most external of the system is a mass of transverse muscle fibres within which are the powerful bundles of the outer series of longitudinal muscle. Within the latter is a very strongly developed layer of transverse fibres which in their turn surround the inner longitudinal series consisting of very prominent bundles. Within this there is a third ring of

⁵⁷ Johnston—Journ. Roy. Soc. N. S. Wales, xlv., 1910, p. 94.

⁵⁸ Fuhrmann—Centr. Bakt., Abt. 1., xxvi., 1899, pp. 618, 621.

transverse fibres, these forming the boundary between the cortex and the medulla (Pl. iv., fig. 5). The inmost transverse musculature is the weakest of the three. The longitudinal bundles are considerably elongated in the dorso-ventral direction. The inner bundles each possess from thirty to forty fibres, whilst the outer have about twenty. The differentiation into inner and outer series is still recognisable laterally though the bundles become much weaker. Dorso-ventral fibres are relatively powerful though not numerous. Scattered throughout the cortex are rounded calcareous corpuscles having a diameter of from 0.007 to 0.015 mm.

Nervous System.—The nervous system is seen to consist in each segment of three pairs of relatively large, longitudinal strands situated in the lateral region. The main nerve lies dorso-laterally to the ventral excretory vessel, the dorsal and ventral accessory nerves lying dorso-laterally, and ventro-laterally respectively from the main nerve. The strands all lie well within the inmost transverse muscular layer. The dorsal accessory and the main nerve pass dorsally over the cirrus sac, the other nerve lying ventrally to it.

Excretory System.—This system consists of the usual two pair of vessels, the ventral pair being much larger than the dorsal. The dorsal trunks possess a lumen of 0.026 mm., and lie medianwards from and just dorsally to the ventral vessel. The surrounding parenchyma is very rich in nuclei. The ventral pair have a diameter of about 0.085 mm. Both vessels are displaced dorsally in the region of the genital duct, the latter passing ventrally to them. A noteworthy point is the presence in the posterior region of each segment of two transverse excretory vessels, a narrow tube connecting the dorsal vessels and a wide tube lying immediately below it and connecting the two ventral vessels. This feature has already been mentioned by Fuhrmann as occurring in *Acoelus vaginatus*. The ventral trunks were readily traceable into the scolex (see Pl. iv., fig. 1). Each became somewhat sinuous and eventually reached the level of the anterior margin of the suckers as a wide vessel which bent round to pass backwards for a short distance, and then transversely behind the retracted rostellum to meet its fellow from the opposite side. Probably the course is different when the rostellum is everted. A narrow commissure connecting the limbs of the loop was detected near the level of the mid-region of the suckers. The dorsal vessels were not traceable into the scolex.

Genitalia.—The genital pores alternate regularly⁵⁹. Each is situated in a shallow cloaca on a prominent papilla just in front of the middle of the margin of each segment. When the cirrus is everted the papilla projects very considerably as is shown in Pl. iv., fig. 4. A female pore is absent.

The male organs are situated in the anterior portion of the proglottis in front of the female genitalia. The testes are numerous, there being about one hundred and fifty arranged in a transversely-lying group of 1.85 mm. in breadth, in the anterior third of the segment. They form a well defined mass which is rather wider at the extremities than in its mid-region. There is no grouping of the glands into two distinct series such as is figured by Fuhrmann⁶⁰ as occurring in *Acoelus vaginatus*. There are two or three rows in the dorso-ventral direction. The vesicles are restricted to the dorsal portion of the medulla. Their diameter is about 0.070 mm. Passing through the middle of the mass, is a collecting tube into which the vas deferens from each gland opens. From near the middle of the collecting vessel there passes away the vas deferens which travels below and usually in front of the testes. After a short course laterally it enters the powerful cirrus sac without having been thrown into any coils. Just within the cirrus sac the vas becomes much enlarged to form a vesicula seminalis. From this the cirrus passes out laterally as a tube with strongly muscular walls and a rather narrow lumen. It lies more or less coiled when at rest, the coils being restricted to the inner half of the cirrus sac. As previously mentioned, the genital duct, or rather the cirrus sac, lies ventrally to both excretory vessels and the main nerve, all of these structures being displaced dorsally in this region.

The cirrus sac is a very long and powerful cylindrical organ occupying one of the upper corners of the segment. In its position of rest it is 0.8 to 1.20 mm. long by about 0.26 mm. broad. Its outer wall consists of a thick layer of muscular tissue while the space between this and the male canal is traversed by the fibres of the retractor muscle of the cirrus, which passes back from the cirrus to be inserted into the sides of the inner portion of the sac (Pl. iv., fig. 4). Passing inwards from the external wall of the latter, there is a very prominent retractor of the sac, the fibres of this muscle coursing inwards from the sac to be inserted into the ventral region of the medullary parenchyma.

⁵⁹ In a few instances the cirrus sac was seen to open on the same side in two successive segments.

⁶⁰ Fuhrmann—*Loc. cit.*, p. 621.

The cirrus when fully everted is seen to be a relatively large organ of about 0.5 mm. long, with a breadth of 0.16 mm. at its base and tapering slightly towards the extremity. It is beset with a great number of very powerful hooks set spirally and as closely as their enlarged bases allow. Each hook has the form shown in Pl. iv., fig. 4, the base being about 0.0145 mm. long. The total length of hook is 0.022 mm. The length of the structure is somewhat less than that of the cirrus hooks in *Acoleus armatus*. Besides, the shape is seen on comparison with Fuhrmann's figure to be different, being intermediate between the latter and that of *Acoleus crassus*, Fuhrm.⁶¹ The base is sunk into the cirrus wall, only the claw remaining projecting.

The female genitalia are characteristic in that there is neither a female aperture nor a vagina. The ovary is a rather broad organ (0.8-0.92 mm.) lying in the middle of the segment and possessing the general form of an arch, the cavity of which faces postero-dorsally. The gland consists of a large number of small tubes which are not readily separable into two groups or wings. In section it is seen that the organ is really bilobed, the middle piece or bridge being rather wide when compared with the size of the ovarian tubes. The bridge is situated quite ventrally, lying immediately above the innermost layer of transverse muscle fibres, the tubes being given off in an antero-dorsal direction. The short oviduct travels posteriorly and slightly dorsally from the middle of the organ. The vitelline gland is a large solid organ of an elongate kidney shape, being about 0.40 mm. broad. Its cavity faces forwards and slightly dorsally, the whole organ lying at the same dorso-ventral level as the ovary, the shell gland lying at a more dorsal level than either. The posterior border of the vitellarium is slightly lobed. The vitello-duct is very short, passing forwards and upwards to the shell gland, which is a small rounded organ lying just antero-dorsally to the yolk gland. Situated in the transverse plane between the ovary and the vitelline gland, is a long thin receptaculum seminis, the outer ends of which may be more swollen than the remaining parts. This structure is connected at its middle with the oviduct just in front of the shell gland. In regard to the closely allied *Acoleus armatus*, Fuhrm. (= *A. vaginatus* (Rud.), Fuhrmann)⁶² states that the powerful cirrus seems to be able to penetrate some part of the parenchyma to liberate spermatozoa which

⁶¹ Fuhrmann—Centr. Bakt., I., xxviii., 1900, p. 370-1.

⁶² Fuhrmann—Centr. Bakt., I., xxvi., 1899, p. 621.

succeed in reaching the thin walled receptaculum and pass thence into the oviduct.

Lying between the testes and the ovary is the uterus, a long, transversely placed, simple tube which becomes modified later by the development of pouches or lobes anteriorly, posteriorly and ventrally. At first this organ is confined to the dorsal portion of the medulla at about the same level as the main mass of the testes, but with advancing ripeness the lobes develop and come to reach the ventral limits of the medulla. The fertilising duct appears to pass forwards above the ovary to enter the uterus somewhat ventrally in its mid-region. The eggs are rounded or elliptical, possessing two shells, the diameter of the outermost being 0.022 mm., that of the embryo being 0.009 mm. The poles of the inner shell are somewhat thickened as in *Acoleus vaginatus*⁶³.

A few remarks regarding the genital rudiments may not be out of place. They become distinctly recognisable in the third segment as a transverse deeply staining area in the middle of the proglottis. Within a distance of one mm. from the anterior end, the rudiments of the cirrus sac, ovary and vitellarium are easily distinguishable and at a very short distance further back one may recognise the testes, uterus and receptaculum seminis. All the structures, especially the cirrus sac, develop rapidly in size.

In regard to the affinities of *Acoleus hedleyi*, it seems to approach very nearly to *A. vaginatus* (Rud.), Fuhrm., the main points of difference being the much greater length of the former—an unimportant detail—the number and disposition of the testes, and the armature of the cirrus.

Typical specimens have been deposited in the Australian Museum.

TENIA CORONATA, *Kreffl.*

(Plate v.)

A Cestode taken from the White-headed Stilt (*Himantopus leucocephalus*, Gould), in the Hunter River District, New South Wales, was originally described by Krefft⁶⁴ as *Tenia coronata*. The name, however, was already pre-occupied in the genus, having been used by Creplin in 1829 for a tapeworm (*Choanotenia coronata*) from certain other Charadriid birds in the Old

⁶³ Fuhrmann—Centr. Bakt., I., xxviii., 1900, p. 370; Krabbe—Bidrag til Kundskab om Fuglenes Baendelorme, 1869, fig. 189.

⁶⁴ Krefft—Trans. Entom. Soc. N. S. Wales, ii., 1873, pp. 220-1.

World. Consequently, a new specific name, *australiensis*, was suggested by me⁶⁵ as the two parasites are distinct. It was also mentioned that the worm appeared to be a *Dilepis*. It is really a *Gyrocoelia*, my error arising from the fact that in the jar containing the type specimen, there were present a number of fragments of a species of *Diorchis*, whose possession of unilateral genitalia and sac-like uterus led me to regard it as a *Dilepis*. Further examination of the latter showed it to be a typical *Diorchis*, viz. *D. flavescens* (syn. *T. flavescens*, Krefft) found in various ducks, the specimens evidently having been placed by mistake into the same receptacle as those from the Stilt. Dried fragments of *Gyrocoelia australiensis* were also found amongst the type material of *Tenia rugosa*, Krefft, i.e. *Acoelus hedleyi*, mihi.

Kreff's account is very unsatisfactory. He mentioned that the total length of the strobila was three and a half inches, the anterior fourth being thin and tapering, and that the scolex possessed four large suckers and a short rostellum. The rest of his information is of no value. There is only a scolex-less fragment in the Museum collection. Sexually mature segments are about 0.37 mm. in length by 0.89 mm. in breadth, the ratio being 2 : 5. In those proglottids in which the uterus has assumed its final form the length (0.060 mm.) is much shorter and the breadth (0.296 mm.) rather greater, the ratio being 1 : 5. The amount of overlapping is not very great.

Body-wall, Musculature, etc.—The state of preservation did not allow of any details being given regarding the subcuticular structures. The cuticle is quite thin. The parenchyma musculature is very peculiar and resembles in general type that found in other members of the Acoleidæ, one of which *A. hedleyi* has already been referred to. The longitudinal bundles are very powerful, consisting of two well-marked concentric series, the bundles of the outer possessing from twenty to thirty fibres, while those of the inner series have from twenty to fifty. The bundles become much smaller laterally but the rings do not become broken. The transverse musculature is quite typical for the genus. The outermost series is very well developed. The middle series, which lies between the two longitudinal rings is also well-marked though not so powerful as the outer. The inmost series is quite weak and was seen only in a few of the sections. Dorso-ventral fibres are easily recognised.

⁶⁵Johnston—Journ. Roy. Soc. N. S. Wales, xlv., 1910, p. 95.

Calcareous corpuscles are fairly abundant, rounded or elliptical structures varying from 5.4μ by 7μ to 7.5μ by 11μ .

The excretory system is similar to that described in *Acoelus hedleyi*. The vessels are situated in the medulla well within the musculature. The ventral stem is rather larger than the dorsal, both possessing a fairly wide lumen. The latter lies some little distance above the former, the male duct passing between them. At the posterior end of each segment there are two transverse excretory vessels, a dorsal and a ventral, connecting each dorsal and ventral longitudinal trunk respectively.

The only portion of the nervous system recognised was the large longitudinal nerve situated laterally from the excretory vessels. It passes just below the genital duct, being displaced somewhat ventrally.

The genital system is also characteristic and resembles that of *Gyrocaelia perversa* as described by Fuhrmann⁶⁶. The male openings alternate irregularly and are located in front of the middle of the lateral margin of each proglottis. There is no prominent genital papilla excepting when the cirrus is more or less protruded. When the latter is at rest there is a narrow canal leading from the genital pore to the male duct. Female apertures are absent. The genitalia appear very early, the uterus and other parts being recognised in the youngest segments examined.

The male organs consist of a small group of about five small testes lying transversely in the middle of the anterior part of the segment in front of the female glands and uterus, and approximating to the dorsal surface; they disappear early. A transversely placed collecting duct receives their secretion. From the middle of this duct the vas deferens passes forwards and then laterally. It travels outwards, passing just below the dorsal excretory vessel, to enter the cirrus sac. A small swelling or vesicula seminalis may be present on the inner portion of the duct. After entering the sac, the vas becomes thrown into a few coils lying in the inner end of it. This narrow duct widens to form the eversible cirrus, a wide tube of from 0.033 to 0.067 mm. in diameter whose inner wall is thickly studded with slender hooks possessing a small basal portion, and a delicate backwardly projecting portion 0.006 mm. long. The sac as already mentioned lies between the excretory trunks and above the longitudinal nerve. It is a rather large organ of about 0.30 mm. in length,

⁶⁶Fuhrmann—Centr. Bakt., I., xxvi., 1899, pp. 618-620.

with a maximum breadth of 0.145 mm. In general shape it is cylindrical or pyriform, being usually of the latter form in sexually mature segments. Its outer wall contains powerful muscles within which there is abundance of a loose parenchymatous tissue pervaded by muscle fibres acting as retractors of the cirrus. There are also well-defined fibres passing inwards from the inner end of the sac itself, their function being that of retractors of the sac. The walls of the vas deferens within the sac contain well-developed longitudinal and circular muscle fibres. When everted the cirrus is seen as a relatively short (0.275 mm.) tube with a broad base (0.10 mm.) tapering considerably towards the free end which measures 0.027 mm. in diameter. The muscular fibres mentioned by Fuhrmann⁶⁷ as passing from the cirrus sac to the cloacal wall in *G. perversa* were distinctly seen in *G. australiensis*, more especially in early sexual maturity.

The female system lacks a vagina. The ovary is a very extensive organ occupying the middle of each proglottid. At maturity it forms a compact mass of about 0.34 mm. in breadth, reniform in shape, the vitellarium and shell gland lying in the posteriorly directed hilus. In younger segments one may readily recognise a transverse bridge connecting the two ovarian lobes; each lobe is very greatly branched. Some of these branches or tubes lie in the dorsal portion of the medulla, the uterus commonly passing between them in the lateral regions of the gland. Portions of the ovary may extend forwards to lie below the anterior section of the uterus and even the testes. The bridge lies ventrally. The oviduct passes backwards and slightly dorsally to enter the shell gland. A receptaculum seminis was not recognised though it seems reasonable to expect the presence of some reservoir in which sperms may be stored. The vitelline gland is a conspicuous reniform organ lying behind the ovarian bridge, and dorso-posteriorly to the shell gland which may at times partly overlie it. The vitellarium and the ovarian bridge lie at the same dorso-ventral level, the rather large rounded shell-gland being situated more dorsally than either of them. The vitello-duct passes away dorsally from the hilus of the gland to join the oviduct within the shell complex.

The uterine duct leaves the shell-gland dorso-anteriorly as a narrow tube which passes forwards above the ovary until it reaches the uterus, opening into it in the median line just behind the testes. The uterus is a very characteristic organ resembling that of other species of *Gyrocampa* in being ring-like. In young

⁶⁷ Fuhrmann—*Loc. cit.*, p. 619.

proglottids it is a simple ring lying in front between the testes and the ovary, laterally just outside of the main mass of the latter gland and frequently between the outer portions of laterally-directed ovarian tubes, and posteriorly, just above the vitellarium on the same dorso-ventral plane as but behind the shell-gland. As development progresses, the uterine wall becomes more or less deeply pouched, especially on its outer side. The cavity becomes filled with a structureless substance which is probably of a mucous nature. A similar occurrence has been noted by Fuhrmann⁶⁸ in the uterus of *Gyrocotyle leuce*. As in the latter species and in *G. perversa* there is present in the mid-line at the posterior end of each segment a dorso-ventral canal into which the uterus comes to open. Neither this canal nor its rudiment was recognised until sexual maturity had been reached. In *G. perversa*, Fuhrmann⁶⁹ found the rudiment appearing early and was able to trace its development. Ripe eggs were not present in the fragment.

The known species of the genus *G. perversa*, *G. brevis*, *G. leuce* and *G. paradoxa*, Linst.⁷⁰, as well as the species under review, are all from birds belonging to the Charadriiformes and seem to be very similar anatomically, the main difference being in regard to their musculature, the structure of the cirrus and the geographical distribution.

TENIA PEDIFORMIS, Kreffl.

There is only a single specimen of this parasite in the Museum collection. It was taken from *Anas superciliosa*, Gmel. Kreffl mentioned *Anas punctata*, i.e. *Nettion castaneum*, Eyton, as another host. Linstow, Wolffhügel and Fuhrmann⁷¹ have already suggested that this species may be synonymous with *Tenia mallens*, Goeze, i.e. *Fimbriaria fasciolaris*, Pall., a statement with which I have agreed⁷². A further examination of Kreffl's specimen confirms the opinion and consequently his name must

⁶⁸ Fuhrmann—Centr. Bakt., I., xxviii., 1900, p. 372.

⁶⁹ Fuhrmann—Centr. Bakt., I., xxvi., 1899, p. 620.

⁷⁰ Linstow—Spolia Zeylanica, iii., 1906, p. 183; Fuhrmann—Zool. Jahrb. Syst., Suppl. Bd., x., Heft 1., 1908, p. 87.

⁷¹ Fuhrmann—Zool. Jahrb., Suppl. Bd. x., Heft 1., 1908, p. 91. Wolffhügel—Beitr. Kenntnis Vogelhelm., Inang., Biss., 1900, p. 80.; Linstow—Centr. Bakt. Orig., I., xii., 1892, p. 501.

⁷² Johnston—Journ. Roy. Soc. N. S. Wales, xliv., 1910, p. 98.

sink into synonymy. The parasite is very poorly preserved and does not allow of a satisfactory account of its structure being given.

The known geographical range of *F. fasciolaris*, Pall., is now greatly widened by the inclusion of two Australian hosts, *Anas superciliosa*, Gmel., and *Nettion castaneum*, Eyton.

TÆNIA CYLINDRICA, Krefft.

(Plate vi.)

Krefft's specimens were taken from the intestine of a Black Duck (*Anas superciliosa*, Gmel.) and are very indifferently preserved. However, enough of the anatomy was made out, to allow of my recognising that they were specifically identical with a few parasites which I collected along with *H. collaris*, Batsch, (*Tænia bairdii*, Krefft), from *A. superciliosa*, shot near Sydney in the latter part of 1910. An examination of Krefft's species shows it to be a *Hymenolepis* and to be synonymous with *H. megalops*, Nitzsch. In view of the fact that Ransom⁷³ has carefully described and figured the anatomy of *H. megalops*, only a short account, more or less confirmatory in nature, need be given here. This author appears to have been the only recent writer who has had an opportunity of studying the species under review. Stiles⁷⁴, in 1896, gave a summary of former accounts and added a few figures of the scolex.

Since Krefft's specimens are strongly contracted, the following account has been based mainly on my own forms. Most of the tapeworms measure about 16 mm., one of them being a fragment which contains six-hooked embryos. The breadth is fairly uniform, measuring about 0.6 mm. The almost spherical scolex (Pl. vi.; fig. 1) is relatively very large and prominent, its breadth and thickness being 1.1 mm. The deep, powerful suckers have a diameter of 0.38 mm. and are directed antero-laterally. Situated on the apex of the head is the opening leading into the rostellar cavity. Segmentation begins immediately behind the scolex, the width in this region being 0.55 mm., gradually increasing to 0.6 mm., this latter breadth being maintained almost to the end of the worm. The final segments in some of the specimens, are slightly narrower and longer than those further forward, and,

⁷³ Ransom—Trans. Amer. Micro. Soc., xxiii., 1901 (1902), pp. 158-167.

⁷⁴ Stiles—Bull. Bur. Anim. Ind., Dept. Agr. U.S.A., 12, 1896, p. 59.

besides, no eggs were present in them. Owing to the presence of very deep inter-segmental constrictions, there is considerable overlapping, the proglottids being somewhat bell-like. The corrugated appearance noted by Dujardin and by Ransom is evident. Lying unilaterally in the posterior half of each segment, is the genital pore situated on a slight projection.

Sections were not cut, hence the relations of the muscular and subcuticular structures were not followed out. Ransom gives a detailed account of the nervous and excretory systems. The main vessels of the latter system are to be recognised in the segments, their arrangement being indicated in Pl. vi, figs. 2 and 3. The sex ducts pass above both excretory canals and the longitudinal nerve. Calcareous corpuscles are very abundant in the cortical tissue.

Male Genitalia.—The three testes lie in the posterior half of the segment, one being situated on the pore bearing side and the other two on the other side of the median line. Their arrangement varies somewhat as may be seen on comparing their position in Pl. vi, figs. 2 and 3, their disposition in fig. 2 resembling that drawn by Ransom. The vas deferens is a short thick, somewhat swollen tube passing forwards to enter the cirrus sac within which it becomes considerably swollen to form an elongate, rather wide, thin-walled inner vesicula seminalis, occupying the major portion of the inner half of the sac. From the outer end of this vesicle a narrow duct passes inwards towards the inner end of the cirrus sac, to bend round and again travel outwards as the cirrus which may or may not lie somewhat coiled within the sac. The inner wall of the cirrus carries a great number of closely set bristles which in the everted organ, project backwards. The cirrus can be protruded to a distance of at least 0.16 mm. The sac is relatively very long, being from 0.3 to nearly 0.5 mm. in length, the breadth being 0.04 mm. in its outer part and 0.06 mm. in its inner portion. Its inner extremity lies postero-dorsally to the ovary, the sac extending from this region postero-laterally in front of the vitelline and shell glands and above the vagina to terminate at the male pore. The latter opens into the narrow genital cloaca just above and behind the female pore.

Female Genitalia.—The ovary is a comparatively large, solid gland lying ventrally in the extreme anterior portion of the segment. It frequently possesses an irregularly bilobed shape. Behind it is the small compact vitelline gland which overlies the shell gland dorsally.

The vagina extends inwards from the female pore, its main mass lying in front of and somewhat ventrally to the cirrus sac. Though its opening is narrow, the duct soon becomes widened to act as a receptaculum seminis. As it passes below the sac just in front of the testes which lie on the right hand (*i.e.* the pore-bearing) side, it again becomes narrowed and eventually reaches the middle of the segment where it comes into relation with the other female ducts.

The uterus develops dorsally to the ovary, but ventrally to the male organs. It finally becomes a well-defined rounded or rectangular sac (Pl. vi., fig. 4), the only other portion of the genitalia persisting at this time being the vagina and the cirrus sac. As mentioned by Ransom, the anterior margin of the uterus lies practically at the junction between the segment to which it belongs, and the preceding one. The eggs are from 34 to 42 μ in diameter, the oncosphere measuring from 23 to 26 μ by from 19 to 23 μ , and its hooks 11 μ .

If the foregoing sketch be compared with Ransom's account, it will be admitted that the parasites are specifically identical. The finding of *H. megalops* in Australian Anatidæ thus greatly widens the range of this Cestode, as the host in question ranges over Australia and New Guinea. This helminth has so far been recorded (according to Fuhrmann's list)⁷⁵ from ten species of Anseriform birds ranging over Europe, North Africa, North and South America and now from Australia.

⁷⁵ Fuhrmann—Zool. Jahrb., Suppl. Bd., x., Heft 1, 1908, pp. 149-158.

III.—REFERENCE TO LETTERING OF THE FIGURES.

a.s.	accessory sac.	p.n.c.	posterior nerve commis- sure.	
c.	cirrus.	pr.	prostate cells.	
c.e.v.	commissural excretory vessel.	r.	rostellum.	
c.h.	cirrus hooks.	v.s.	receptaculum seminis.	
c.m.	cirrus musculature.	s.	sucker.	
c.n.f.	concomitant nerve fas- cicle.	s.c.c.	subcuticular cells.	
c.r.	cirrus retractor.	s.c.c.m.	subcuticular circular muscle.	
c.s.	cirrus sac.	s.c.l.m.	subcuticular longitud- inal muscle.	
c.s.m.	cirrus sac musculature.	s.g.	shell gland.	
c.s.r.	cirrus sac retractor.	t.	testes.	
cu.	cuticle.	tr.v.	transverse excretory vessel.	
d.e.v.	dorsal excretory vessel.	tr.m.	} transverse muscles.	
d.tr.v.	dorsal transverse vessel.	tr.m. 1,		
d.v.m.	dorsoventral muscle- fibres.	tr.m. 2,		
g.c.	genital cloaca.	tr.m. 3,		
g.e.	genital eminence.	u.	uterus.	
g.p.	genital pore.	u.d.	uterine duct.	
g.r.	genital rudiments.	u.o.	uterine opening.	
l.n.	longitudinal nerve.	v.	vagina.	
l.m.	} longitudinal muscles.	v.d.	vas deferens.	
l.m. 1			v.g.	vitelline gland.
l.m. 2			v.e.v.	ventral excretory vessel.
l.a.n.	longitudinal accessory nerve.	v.s.	vesicula seminalis.	
n.	nerve.	v.tr.v.	ventral transverse vessel.	
o.d.	oviduct.	v.d.	vitelline duct.	
ov.	ovary.			

The figures were drawn by Mr. W. A. Birmingham from the author's original camera-lucida drawings.